Freie Universität Bozen
Libera Università di Bolzano
Free University of Bozen · Bolzano

Fakultät für Naturwissenschaften und Technik | Facoltà di Scienze e Tecnologie | Faculty of Science and Technology

FREE UNIVERSITY OF BOZEN-BOLZANO

FACULTY OF SCIENCE AND TECHNOLOGY

ACADEMIC YEAR 2013/2014
ADMISSION TEST

Each of the following questions has one and only one correct answer. Please, mark the correct option (among (A), (B), (C), (D), (E)) on the answer sheet.

NB The final grade of the admission test will be obtained by summing the points awarded to each answer using the following scheme:

- Right answer = 1 point.
- Wrong answer = -0.25 points.
- Unanswered question = 0 points.

Question 1. Two pointlike electric charges q_1 and q_2 attract or repell each other with a force F described by Coulomb's law $F = k\,\dfrac{q_1 \cdot q_2}{r^2}$. Suppose that both charges become twice as large and the distance between them doubles, then the force:

(A) becomes twice as large;

(B) is halved;

(C) becomes four times as large;

(D) becomes eight times as large;

(E) does not change.

Question 2. Which of the following statements is true?

(A) Gamma rays are not electromagnetic radiations.

(B) Light cannot propagate in vacuum.

(C) Sound can propagate in vacuum.

(D) Sound has a wavelike character.

(E) The speed of light does not depend on the propagation medium.

Question 3. For which of the following reasons does food cook more quickly in a pressure cooker than in a traditional pot?

(A) Evaporation is reduced.

(B) The increase of pressure breaks the cells apart.

(C) When pressure increases, so does the temperature of the boiling point, therefore chemical reactions become quicker.

(D) When pressure increases, the temperature of the boiling point decreases, therefore chemical reactions become slower.

(E) When pressure increases, the temperature of the boiling point decreases, therefore it takes a shorter time to reach that temperature.

Question 4. Let the Equator be a perfect circle, whose circumference measures u meters. How many meters longer than u must a rope be so that it can be tied around the Equator 1 meter above the Earth's surface?

(A) π meters;

(B) $\pi \cdot u$ meters;

(C) $2\pi \cdot u$ meters;

(D) 2π meters;

(E) $\dfrac{1}{u}$ meters.

Question 5. Two dice are rolled. What is the probability of rolling the sum of 4?

(A) $\dfrac{1}{12}$

(B) $\dfrac{1}{36}$

(C) $\dfrac{1}{9}$

(D) $\dfrac{1}{6}$

(E) $\dfrac{1}{4}$

Question 6. A team of 4 persons is to be selected among 25 people. In how many different ways can the choice be made?

(A) $25 \cdot 24 \cdot 23 \cdot 22$

(B) 254

(C) 25!

(D) 425

(E) $4 \cdot 25$

Question 7. An art historian has observed that in every painting by the famous painter Magnus Pennellus there appear at least one flower or one butterfly (and possibly both). Moreover, he has noticed that if there is no flower, there is at least one mushroom and that if there is one butterfly, there is certainly also the sun.
Only one of the following scenes can be present in a painting by Pennellus. Which one?

(A) A scene without flowers and without the sun.

(B) A scene with flowers only.

(C) A scene with only mushrooms and the sun.

(D) A scene with only mushrooms and butterflies.

(E) A scene with flowers and butterflies but without the sun.

Question 8. A university professor, who whishes to remain anonymous, asserts that for any choice of an even number of university professors, at least half of them are arrogant.

Should this opinion be true, then necessarily:

(A) precisely half of all the university professors would be arrogant;

(B) there would be an even number of arrogant university professors;

(C) setting aside at most one of them, all university professors would be arrogant;

(D) the university professor saying this would be arrogant;

(E) there would be an uneven number of arrogant university professors.

Question 9. Five seventy-year-old engineers, who attended the University together, remember their youth and recall the day of their admission test.
Only one of them can exactly remember all the details of that day, but each of them can correctly remember at least one detail.

Albert says that it was Tuesday, the room was on the 2^{nd} floor and the tables were white.

Biagio says that it was Thursday, the room was on the 2^{nd} floor and the tables were white.

Christopher says that it was Thursday, the room was on the 3^{rd} floor and the tables were green.

Diego says that it was Tuesday, the room was on the 3^{rd} floor and the tables were white.

Erwin says that it was Tuesday, the room was on the 3^{rd} floor and the tables were green.

Who can recall all the details correctly?

(A) Albert

(B) Biagio

(C) Christopher

(D) Diego

(E) Erwin

Question 10. Two long-stay car parks are situated near to the airport of Flugstadt. They offer the following fares:

Parking P1: 20€ a day for the first 2 days, 10€ a day for the following days
Parking P2: 15€ a day for the first 5 days, 8€ a day for the following days

Which of the statements below is true?

(A) Parking P2 is always the cheapest.

(B) Parking P1 is the cheapest if the stay is longer than 4 days.

(C) Parking P2 is the cheapest for stays up to 6 days.

(D) Parking P1 is the cheapest for stays between 5 and 7 days.

(E) Parking P2 is the cheapest only for the first 3 days.

Question 11. It has been estimated that in the last decades the weight of television sets has decreased on average by $\frac{2}{5}$ every 10 years. If this is true, which relation holds between the weight p' of a television set produced in 2010 and the weight p of one manufactured in 1980?

(A) $p' = \left(\frac{3}{5}\right)^3 \cdot p$

(B) $p' = \left(1 - \left(\frac{2}{5}\right)^3\right) \cdot p$

(C) $p' = p - \frac{2}{5} \cdot p$

(D) $p' = \left(\frac{2}{5}\right)^3 \cdot p$

(E) $p' = p - \frac{2}{15} \cdot p$

Question 12. Only one of the following statements is true. Which one?

(A) The equation $|x^2 - 3| = 2$ has no real solutions.

(B) Let x, y, z be real numbers with $y \neq 0$ and $x < z$. Then $\frac{x}{y} < \frac{z}{y}$ holds.

(C) Let a, x, y be real numbers and suppose $a > 0$. Then $a^x < a^y$ whenever $x < y$.

(D) The solution set of the inequality $x(x + 2) < x$ is the interval of real values x such that $x < -1$.

(E) The inequality $(a + b)^2 \geq a^2 + b^2$ is satisfied for any couple of real positive numbers a and b.

Question 13. The DNA structure was detected 60 years ago by Watson and Crick. DNA is composed by a nucleotides chain that is

(A) arranged in a single helix;

(B) arranged in a double helix;

(C) arranged in a triple helix;

(D) arranged in a quadruple helix;

(E) arranged as a single filament.

Question 14. Inhalation of helium (a noble gas) in the lungs causes the voice to sound distorted. What is the cause of this effect?

(A) Helium reduces the lungs' volume.

(B) The density of helium is higher than that of the air.

(C) Helium gets bound to the respiratory system.

(D) The density of helium is lower than that of the air.

(E) Helium reacts with oxygen.

Question 15. Unlike Bacteria and Archaea, Eukarya

(A) have cells with a nucleus;

(B) have very small cells;

(C) are unicellular;

(D) are made of cells;

(E) have cell walls.

Question 16. Gregor Mendel used pea plants to study

(A) flowering;

(B) gamete formation;

(C) the inheritance of traits;

(D) cross-pollination;

(E) agricultural crops.

Question 17. Lady beetles are excellent hunters and are one of the major beneficial organisms that keep aphid populations down. Which of the following terms refers to the lady beetle's ability to keep the aphid populations down?

(A) Mutualism

(B) Habitat

(C) Predation

(D) Ecological niche

(E) Competition

Question 18. What is the maximum size of a peptide translated from an mRNA of 150 nucleotides?

(A) 150 amino acids.

(B) 100 amino acids.

(C) 50 amino acids.

(D) 15 amino acids.

(E) More than 150 amino acids.

Question 19. Which of the following is a primary macro-nutrient for plants?

(A) Carbon

(B) Lead

(C) Arsenic

(D) Nickel

(E) Vanadium

Question 20. Which of the following tree species was introduced by man in Central Europe?

(A) Sessile oak

(B) Field elm

(C) Black locust

(D) Sycamore maple

(E) Common ash

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KEYS

Answer 1: E

Answer 2: D

Answer 3: C

Answer 4: D

Answer 5: A

Answer 6: A

Answer 7: B

Answer 8: C

Answer 9: D

Answer 10: D

Answer 11: A

Answer 12: E

Answer 13: B

Answer 14: D

Answer 15: A

Answer 16: C

Answer 17: C

Answer 18: C

Answer 19: A

Answer 20: C